coating can labels. In an attempt to obtain some general durability information, staff contacted Chuck Donaldson who is a Customer Service Representative for Dunn-Edwards. Mr. Donaldson indicated that for Dunn-Edwards lacquer (LQ 104 X Decolac-Semi Gloss) it is expected to hold-up for three to four years, if the edges are sealed properly. Whereas, Dunn-Edwards' varnish (V 197 X Syngloss) could be expected to last 5 years or longer. Mr. Donaldson pointed out that the durability of a coating is dependent on many factors, including: surface preparation, application technique, substrate coated, and exposure conditions. Therefore, it is expected that if applied correctly, compliant coatings should be as durable as traditional lacquers. (Page 3-17)

Comment: Testimony at the May 24, 1996, public workshop identified "more frequent recoating" as an adverse impact resulting from use of complying varnishes or waterborne clear coatings as substitutes for conventional lacquers. Lacquer finishes applied to new residential construction commonly last as long as 15-20 years before re-finishing is needed. Complying varnishes and waterborne clear coatings are generally expected to last about half that length of time.

1-39 Mr. Donaldson recalls the conversation recounted above. The caller implied that he was a homeowner, with kitchen cabinets in need of refinishing, and wanted information on various coating options. According to Mr. Donaldson, the conversation is misreported in several respects. Mr. Donaldson stated "three to four" years as the minimum durability of a lacquer finish under adverse exposure conditions. Later in the conversation, Mr. Donaldson mentioned "five years" as the average durability of varnish under normal exposure conditions. Believing that he was talking with a homeowner unskilled in coatings application, he tactfully attempted to steer the caller away from selecting lacquer because the use of such coatings requires skillful spray application of a flammable liquid. Lacquer is generally recommended only for use by professional contractors with special training.

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More Reactivity

Based on various studies conducted in the field of atmospheric chemistry, many different types of VOCs are emitted into the atmosphere, each reacting at different rates and with different mechanisms. Reactivity is the ability of a compound to accelerate the formation of ground-level ozone. The architectural coatings industry has supported this viewpoint and is

actually involved in financing additional studies to further study the actual mechanistic and kinetic reactivities of different VOC species. The industry believes that VOC control strategies which take reactivity into account can potentially achieve ozone reductions in a more cost-effective manner than strategies which treat all non-exempt VOCs equally. (Pages 3-17, 3-18)

Comment: EL RAP's interest in reactivity goes far deeper than cost-effectiveness of control strategies. The basic issue is whether, or to what extent, mass-based VOC controls may be counterproductive to ozone reduction. As noted in the previously submitted white paper titled *Outlawing Paint in the Name of Clean Air: A Prime Example of Regulatory Failure,* "regulators have focused exclusively on reducing the amount of VOC, without regard to the type. Different kinds of VOC, however, have different degrees of 'reactivity,' that is, ability to accelerate the formation of ground-level ozone. Banning coatings solely on the basis of VOC content can have unintended impacts on the character and timing of VOC emissions; these impacts cause more reactive VOC to be used in place of less reactive VOC, and more emissions to occur at times when weather conditions promote ozone formation."

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According to comments made by industry, it is alleged that solvents used in reformulated coatings may be more reactive than the solvents used in traditional lacquers. Different types of solvents have different degrees of "reactivity." Furthermore, industry contends that acetone-based lacquers and water-based coatings perform best under warm, dry weather conditions, and are typically recommended for use between May and October which is typically the peak ozone season.

The contention that more reactive solvents will be used in lieu of traditional less reactive solvents is somewhat misleading because traditional lacquers currently contain reactive and highly toxic solvents such as toluene, xylene, MEK, etc. Instead, Hartley (sic), et al., (1992) states, "The respeciated organic gas emissions from use of solvent-borne architectural coatings are 24% more reactive than the official (VOC) inventory would suggest." (Page 3-18)

1-41 **Comment:** Conventional lacquer solvent blends contain various VOCs, some more reactive than others. As discussed in more detail in a later comment, acetone-reduced lacquer formulations are expected to decrease the amount of less reactive VOC and increase the amount of more reactive VOC in the non-acetone solvent

portion of the coatings. The quote from Harley, et al., is a criticism of the SCAQMD's current VOC speciation profile for architectural coatings, which is known to be grossly inaccurate. Furthermore, waterborne clear coatings contain substantial amounts of cosolvent glycol compounds believed to be highly reactive. Harley, et al., in the same document states: "A revised speciation profile for waterborne coatings has been developed based on data from Table 6.1-1 of Rogozen et al. (41) and is 117% more reactive than the profile used in the official inventory."

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CARB incorporated the idea of a reactivity-based control strategy into their California Clean Fuel/Low Emissions Vehicle regulations, where reactivity adjustments [sic] factors are employed to place regulations of exhaust emissions from vehicles using alternative fuels on an equal ozone impact basis. The CARB supports a similar strategy for consumer products and industrial emissions, and recently contracted Dr. William Carter, University of Riverside [sic], Center for Environmental Research and Technology, College of Engineering, for a two year study to assess the reactivities of VOC species found in consumer products and industrial emissions inventory. Dr. Carter, a world renowned researcher of reactivities of various VOC species, will specifically evaluate glycol ethers, esters, isopropyl alcohol, MEK, and octanol, since these are typically found in both water-based and solvent-based coatings. These specific VOCs have been prioritized on contribution to overall emissions inventory, mechanistic reactivity uncertainties, and inconsistency in the current reactivity data. This information is needed to reduce the uncertainties regarding reactivity factors for reactive VOCs which may be useful in developing future reactivity-based control strategies. This study is proposed to be carried out between April 1996 and March 31, 1998. (Page 3-18)

Comment: The ARB-sponsored research on atmospheric reactivities of selected VOCs deals specifically with VOC emissions from consumer products other than architectural coatings, which ARB has no authority to regulate under the California Clean Air Act. Key issues related to reactivities of VOC species typically emitted from architectural coatings will therefore remain unexamined, unless the District's own study is expanded to include such issues.

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To address the issue of reactivity of VOCs staff is currently working with CARB on their Reactivity Advisory Committee, recently formed to specifically evaluate reactivities of selected VOCs. Staff is also monitoring the progress with the North American Research Strategy for Tropospheric Ozone to evaluate research studies on reactivity conducted at the national level. In addition to the AQMD's participation in the aforementioned studies, Dr. Carter has been retained to carry out an experimental and computer modeling study to investigate the atmospheric ozone formation potential of selected VOCs emitted from consumer products and industrial sources. (Page 3-18)

Comment: Two EL RAP member companies are NARSTO sponsors, one of which is sponsoring a research program element dealing specifically with VOC emissions from architectural coatings. (See previously submitted copy of research proposal.) We invite SCAQMD to go beyond merely monitoring, and to participate in sponsoring the NARSTO research.

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As noted previously, acetone, discussed in the previous sections, has been de-listed by the EPA, CARB, and AQMD as a reactive VOC because of the preponderance of scientific data indicating its very low level of reactivity. Recent analysis conducted for AQMD Rule 102-Definition and Terms and Rule 1136-Wood Coatings indicates widespread use of products reformulated with acetone is expected. All indications are, therefore, that less, not more, reactive organic compounds are likely to be used in lacquer reformulations using acetone. (Page 3-19)

Comment: Architectural lacquers formulated with acetone as a major solvent will have serious performance limitations and deficiencies related to the extremely fast evaporation rate of acetone. To offset these characteristics, the VOC solvent portion of such coatings will not be a conventional lacquer solvent blend, but will likely consist primarily (if not exclusively) of glycol compounds such as ethylene glycol monobutyl ether, a slower evaporating solvent that is a principal component of lacquer retarder. These glycol compounds are believed to be generally more reactive than typical lacquer solvent components (e.g., petroleum naphtha, methyl ethyl ketone, and toluene). Thus, the amount of VOC solvent would decrease in these new formulations, but the reactivity of the remaining VOC solvent would increase. Ozone formation impacts may be equal or greater.

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Comment letter # Smith & Khachigian to SCAQMD

Mr. Darren W. Stroud
April 21, 1999
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Organic compounds exhibit wide variations in reactivity with respect to ozone formation. NRC, *Rethinking the Ozone Problem* at 153, 154, 160, 161. The relative reactivities of individual compounds can differ by more than an order of magnitude from one compound to another. Russell et al., "Urban Ozone Control and Atmospheric Reactivity of Organic Gases," *Science* (1995) at 491. Ignoring reactivity may lead to measures that are ineffective or counter-productive. *Id.* at 491, 495. Reactivity-based regulatory systems will reduce more ozone at all cost levels than mass-based systems. McBride et al., "Cost-Benefit and Uncertainty Issues in Using Organic Reactivity to Regulate Urban Ozone", *Environmental Science & Technology* (vol. 31, no. 5 1997) at 241. On one scale, the compounds in solvent-borne coatings, mineral spirits, are roughly half as reactive as those emitted by motor vehicles. Harley et al., "Respeciation of Organic Gas Emissions," *Environ. Sci. Technol.* (1992) 2395 at 2401, Fig. 1. On the other hand, the glycol compounds in water-borne architectural coatings have been described as low-volatility species. *Id.* at 2400. Dr. William
6-13 P.L. Carter recently concluded that current reactivity scales may be overestimating the ozone impacts of mineral spirits and similar petroleum-based mixtures by a factor of 2 or more. "Investigation of the Atmospheric Ozone Formation Potentials of Selected Mineral Spirits" (July 25, 1997).

These results are not surprising considering the physical properties of typical mineral spirits, which are so-called long chain alkanes of C_6 or greater.

The Draft SEA contains (at 4-17 to 4-21 and 5-3 to 5-4) purported discussions of the reactivity issue. But it fails to assess the reactivity effects of any 2002 limit on any coating category, as required. In particular, the 2002 limits will outlaw all solvent-borne non-flats, industrial maintenance coatings, and quick-dry enamels. Therefore, makers, sellers, and users will be forced to manufacture, sell, and apply water-borne substitutes. The best scientific evidence extant to date and, based thereon, the widely-held hypotheses of the leading experts,
6-14 strongly suggests, with a high degree of probability, that the glycol compounds prevalent in the substitute water-borne products are far more reactive than the mineral spirit compounds prevalent in the outlawed solvent-borne products.

The Draft SEA ignores this data. It states (at 4-20) that it is "not . . . prudent" to act on such data because it is

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